LANGUAGE REGRESSION IN AUTISM SPECTRUM DISORDERS:

INVESTIGATING ADULT OUTCOMES 30-YEARS LATER

by

Sarah Harward

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STATEMENT OF DISSERTATION APPROVAL

The dissertation of **Sarah Harward**

has been approved by the following supervisory committee members:

Anne E. Cook	, Chair	**4/28/2014** Date Approved
Deborah Bilder	, Member	**4/28/2014** Date Approved
Hilary Coon	, Member	**4/28/2014** Date Approved
William R. Jenson	, Member	**4/28/2014** Date Approved
William M. McMahon	, Member	**4/28/2014** Date Approved

and by **Anne Cook**, Chair/Dean of

the Department/College/School of **Educational Psychology**

and by David B. Kieda, Dean of The Graduate School.

ABSTRACT

Several studies have compared the outcomes of children with and without language regression; however, no studies to date provide outcome data investigating the early effect of language regression on adult outcomes. This study compared current adult functioning of individuals who were diagnosed with autism during childhood and reported to have language regression to those without reported language regression. Thirty-year follow-up data for participants with early childhood language regression were available for 118 participants in the follow-up study. Outcome measures included standardized assessments of diagnostic status, cognitive ability, and adaptive behavior. Demographic variables, indicators of independence, social relationships, medical and psychiatric conditions, and social service use were also recorded. Adult outcome results for children with and without language regression suggest that despite language regression occurring in 34% of children diagnosed with Autism Spectrum Disorder, this occurrence does not affect later adult outcomes in comparison to those without language regression. This information is compelling, suggesting that while language regression can be devastating for children with ASD and their families, the potential adult outcomes are similar to those without reported language regression.

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CHAPTER 1

INTRODUCTION

Over the years, researchers, clinicians, and parents have reported an unusual phenomenon in the early onset of autism. The majority of early childhood Autism Spectrum Disorder (ASD) diagnoses are made based on a child showing abnormalities in social and communicative development in the first year of life. However, there is a second and much smaller grouping of children with autism who are reported to have typical development in the first year or two of their lives, but then lose skills that they had previously acquired; they concurrently experience the onset of symptoms characteristic of autism. This acquisition and subsequent loss of language and skills can be devastating to parents and caregivers. To date, little information is known about the long-term effects such language regression may have in adulthood. The goal of this dissertation is to compare current adult functioning of individuals who were diagnosed with autism during childhood and reported to have language regression to a comparable group without reported language regression. First, however, it is necessary to provide background information on ASD as well as a review of the current research available on language regression in ASD and adult outcomes.

Characteristics of Autism

Individuals diagnosed with an ASD present with a grouping of severe problems that are frequently evident by early childhood. In Leo Kanner's (1943) original description of autism, he noted a combination of symptoms including inflexibility, rigidity, a desire to be alone, obsessiveness, echolalia, delayed use of functional language, and inability to relate to other people. Since then, many of Kanner's initial observations have become established diagnostic criteria in the diagnosis of Autism Spectrum Disorders. Autism is currently described as a lifelong developmental disorder with a common cause at the genetic, cognitive, and neural levels (Hill & Frith, 2003).

Specific diagnosis criteria, including impairment in social interaction, difficulty with communication, and the presence of stereotyped behaviors, are described in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV; American Psychological Association, 1994). The most fundamental characteristic of those diagnosed with autism is a "gross and sustained" impairment in social interaction. Often this is expressed in the form of impaired nonverbal social behaviors, difficulty establishing peer relationships, lack of spontaneous seeking in shared enjoyment, lack of social-emotional reciprocity, and decreased awareness of others. Individuals with autism may demonstrate repetitive or restrictive behavior patterns and may have interests or preoccupations that are strange or abnormally intense. Often individuals with autism are inflexible and adhere to nonfunctional routines. Body posture may be stereotyped and motor movements such as clapping, flapping, rocking, or swaying may be observed. Additionally, individuals diagnosed with autism often become fascinated with movement and spinning, or they may become highly attached to inanimate objects.

Although the DSM-IV contains the diagnostic criteria for the disorders, there is a large amount of variability in the characteristics of individuals with autism. The term ASD is used to describe a group of individuals that vary in terms of symptomology, linguistic ability, and intelligence (Hill & Frith, 2003). Asperger disorder is an example of a condition that exists within the spectrum but varies somewhat from autism. These individuals show impairments in social interaction and restrictive and repetitive behaviors, but show no significant delays in language development, cognitive development, and adaptive behavior (American Psychological Association, 1994). Also within the spectrum exists another diagnosis named pervasive developmental delay, not otherwise specified (PDD-NOS). This condition includes those who do not meet all of the diagnostic criteria for autism or Asperger disorder but exhibit similar symptoms. This may be due to their symptoms being atypical, less frequent or intense, or the onset occurred after the age of three (American Psychological Association, 1994).

Individuals diagnosed with autism, according to DSM-IV criteria, also display marked impairments of verbal and nonverbal communication skills (American Psychological Association, 1994). Those with autism may fail to develop spoken language, or the development of spoken language may be significantly delayed. Although communication difficulties are a core symptom among those with autism, there is great variation among individuals. As previously noted, individual abilities may range from adequate conversational skills to being completely nonverbal (Rice, Warren, & Betz, 2005), and can vary with early language development and acquisition.

Associated Comorbid Disorders and Behaviors

Several medical and psychiatric conditions are commonly identified in people who also have ASD, such as intellectual disabilities, epilepsy, mood disorders, anxiety disorders, attention deficit-hyperactivity disorder, tics, and psychotic disorders (Ghaziuddin, Weidmer-Mikhail, & Ghaziuddin, 1998; Lainhart, 1999). A study by Eaves and Ho (2008) identified comorbid psychiatric difficulties in 77% of their adult sample, including depression, obsessive-compulsive disorder and other anxiety disorders, bipolar disorder, Tourette's disorder, and conduct disorder. Recent research investigating mortality among individuals with autism spectrum disorders found an elevated mortality risk associated with ASD (Bilder et al., 2013). However, Bilder et al. (2013) concluded the elevated mortality risk associated with ASD appeared related to the presence of comorbid medical conditions and intellectual disability rather than ASD itself. These associated comorbidities amplify the difficulties experienced by people with ASD and their families. Diagnosis and treatment of these disorders is especially complicated in people with ASD due to the range of preexisting impairments they suffer (Lainhart, 1999). These disorders further increase the heterogeneity between individuals with ASD and obscure the picture of the natural developmental progression. Many types of maladaptive behaviors are associated with ASD, including toileting difficulties, aggression, destructiveness, self-injurious behavior, temper tantrums, problems with eating, public sexual behavior or nudity, and sleep disorders (Howlin, 2002; Lainhart, 1999). Several of these behaviors may be attributable to impairments in communication ability, yet they remain challenges even for those with proficient communication abilities. Although the frequency of these problem behaviors may be low, their intensity can

prohibit a person from being accepted in social and work environments and from functioning independently.

Due to the varying severity and symptomatology associated with Autism Spectrum Disorders, research related to predictive outcomes, especially adult outcomes, continues to be necessary and valuable in order to plan for and provide the needed and appropriate services for individuals diagnosed with ASD and their caregivers.

Regression in Autism Spectrum Disorders

As previously mentioned, the onset of autism has been reported to occur in one of two patterns (Ozonoff, Heung, & Thompson, 2011). In the first pattern and the majority of cases, children show marked abnormalities in social interaction, communication, and the presence of stereotyped behaviors in the first twelve months (American Psychological Association, 1994; Ozonoff et al., 2011). In the second pattern, typical development is observed in children for the first year to 2 years of life, followed by rapid and severe deterioration in the previously acquired and developed skills (Matson & Kazlowski, 2010; Ozonoff et al., 2011). This second pattern is sometimes referred to as autistic regression or regressive autism. This phenomenon was first detailed in the 1970s by reporters in Japan (as cited in Kosbayashi and Murata, 1998) and continued to receive more attention in the 1980s (as cited in Ozonoff et al., 2011; Hoshino, Kaneko, Yahima, Kumashiro, Volkmar, & Cohen, 1987; Kurita, 1985; Volkmar & Cohen, 1989). Meilleur and Fombonne (2009) reported that regressive autism affects approximately one-fifth to one-third of children who meet the diagnostic criteria of an autism spectrum disorder; however, rates of regression vary due to differing definitions of regression and reporting

methods (i.e., parent report, doctor report, and research studies). Definitions within research studies continue to produce differing results, possibly due to their descriptions of regression varying from "any deterioration," "fluctuating loss," three versus five communicative words, and assorted lengths of time regarding "normal use," (see Table 1 for rates of regression by study). Regression in autism has been reported to affect communication, social abilities, adaptive skills, motor ability, eye contact, social interest, and behavior (Davidovitch, Glick, Holtzman, Tirosh, & Safir, 2000; Goldberg et al., 2003; Lord, Shulman, & DiLavore, 2004; Ozonoff, Williams, & Landa, 2005; Siperstein & Volkmar, 2004). However, several studies have found loss of language skills to be the most common type of regression reported by parents (Goldberg et al., 2003; Siperstien & Volkmar, 2004).

Language Regression in ASD

Language regression or loss of language is often more easily noticed by caregivers and can be easier to measure than loss in other skill areas such as social engagement and responsiveness (Goldberg, 2003; Lord et al., 2004; Shinner, 2001). Although some researchers have argued that regression in autism correlates with poorer outcomes (Bernabei, 2007; Brown & Prelock, 1995; Davidovich et al., 2000; Giannotti et al., 2008; Hansen et al., 2008; Lord et al., 2004; Luyster et al., 2005; Meilleur & Fombonne, 2009; Richler, 2006; Werner et al., 2005), ultimately, the literature is inconclusive regarding the relationship between regression and adult outcomes. Table 2 summarizes adult outcomes for 14 studies as a function of whether there is a difference between individuals with and without language regression.

Furthermore, to date, we find that prevalence and outcomes greatly differ due to the varying definitions of regression, participant characteristics, sample size, and time investigating longitudinal outcomes (Jones & Campbell, 2009; Lord et al., 2004). For example, and as can be seen from the definitions in Table 1, language regression can be interpreted as several different phenomenon, ranging from a complete loss of language after a period of normal development, a slowing or lack of progression to language milestones (plateau), and a returning to single word requests from the use of three-or-four-word sentences. There is a limited amount of research with varying outcomes associated with language regression for individuals with ASD, and the majority of that research focuses on children and younger populations with ASD and the clinical characteristics, autism symptomatology, adaptive functioning, and behavioral adjustment associated with language regression.

Language and Communication

With regard to research differences found in areas related to communication and language skills, Brown and Prelock (1995) found impaired communication skills for individuals with regression versus nonregression. Additionally, nine out of the 43 participants who experienced a period of language regression were perceived by their parents to use less well-developed oral communication skills than those individuals with autism who did not experience language regression. However, Davidovitch et al. (2000) reported verbal communication in favor of children who had experienced regression. Research identifying differences in more than one area include Luyster et al. (2005), who reported poorer social-communication behavior for children with regression versus no

regression at 36 months, despite the regression group demonstrating greater social communication skill mastery at 24 months, and Bernabei et al. (2007), who found poorer language, communication, and adaptive-play skills for regressed versus nonregressed children with autism. Juxtaposing research includes Kobayashi and Murata's study (1998) and Siperstien and Volkmar's (2004) study, both of which found no differences in communication between groups. Landa et al. (2007) assessed toddlers prospectively and found that children with language regression demonstrated age appropriate social and communication skills at 14 months and functioned similarly to counterparts without regression at age 24 months in several social and communicative domains measured.

Adaptive Behavior

Of the regression studies investigating adaptive and social skills, Werner et al. (2005) found social reciprocity to be more impaired for children with regression versus nonregressed comparison groups; however, no differences were identified in communication or adaptive functioning between groups, and no differences were found between regression groups on measures of aberrant behavior. Richler et al. (2006) also found social reciprocity to be more impaired for children with regression versus nonregressed comparison groups, but they found no difference in communication or adaptive functioning between groups. Hansen et al. (2008) also reported that children with ASD who experienced regression had poorer adaptive communication skills and were rated as more lethargic by parents than children who did not experience regression. Both Kobayashi and Murata (1998) and Siperstien and Volkmar (2004) reported no differences in adaptive functioning between groups.

Autism Symptomatology

Giannotti et al. (2008) reported children with regression demonstrated greater autism severity when compared to nonregression counterparts as measured by the Childhood Autism Rating Scale (CARS), an autism checklist, whereas Meilleur and Fombonne (2009) reported that the presence of language regression resulted in no differences in autism symptom scores. Lord et al. (2004) found few differences in autism symptomatology between children with ASD with and without language regression at 5 years of age. As previously mentioned, Siperstien and Volkmar (2004), who found no difference in communication or adaptive functioning between groups, also found no difference between language regression and behaviors characteristic of autism. Werner et al. (2005) found social reciprocity to be more impaired for children with regression versus nonregressed comparison groups; however, no differences were identified in communication or adaptive functioning between groups and no difference between regression groups on measures of aberrant behavior. Baird et al. (2008) found similar symptom severity for children with autism across language groups; however, children with broad ASD diagnoses showed greater symptom severity in the presence of some language regression versus no regression. Jones and Campbell (2010) divided children into four groups based on language development (i.e., regression, plateau, general delay, no delay) to investigate developmental, adaptive behavior, symptom severity, and behavioral adjustment variables. Results found similar nonlanguage developmental history, equal risk for seizure disorder, and comparable behavioral adjustment. Groups did not differ with respect to autism symptomatology.

Overall, the available research investigating language regression in ASD is

inconclusive. Additionally, while the current literature provides varying results in the effects of language regression, none provide evidence on the long-term effects or outcomes that language regression may have for individuals with autism in adulthood. In the broader scheme, some attention has been given to the adult outcomes of people with ASD; however, the proportion of resources and research focused on adults with ASD has historically been minute compared to that given to children. Large scale efforts are now underway by community support groups, provider groups, governments, and research organization to understand the natural progression of ASD across the lifespan and to support adults with autism and their families to achieve the best possible outcomes.

General Adult Outcomes in ASD

Rutter, Le Couteur, and Lord (1967) initiated the practice of categorizing the outcomes of adults with ASD using broad social and educational or occupational classifications. Since then, several investigators have refined and expanded the system (Billstedt et al., 2005; Eaves & Ho, 2008; Howlin et al., 2004; Lotter, 1974; Marriage, Wolverton, & Marriage, 2009). Outcome classifications usually include five nodes and range from Very Poor (i.e., the person cannot function independently in any way) to Very Good (i.e., achieving great independence; having friends and a job). To date, while findings from outcome studies continue to vary, approximately 60% of the samples studied fall within the Fair, Poor, or Very Poor ranges (Billstedt et al., 2005; Eaves & Ho, 2008; Farley et al., 2010; Howlin et al., 2004). See Table 3 for outcome categorization results in previous studies.

In one of the earliest studies of investigating outcomes in ASD (termed "infantile

psychosis" in the original publication), Rutter and colleagues (1967) examined adolescent outcomes for 63 individuals who had been identified with autism as children between 1950 and 1958 through clinical and educational programs at the Maudsley Hospital Children's Department. About 20% of the sample experienced a developmental regression in early childhood. The sample included individuals at all levels of intellectual ability, with 43% having severe intellectual disability, and 29% percent having IQs in the near-normal or normal ranges. Like other studies from this period, half of the participants were institutionalized at the time of the outcome assessments. The investigators noted prognosis for these individuals was poor, as only 17% could be described as “well adjusted.” One person was described as having "normal" adult functioning, and eight more were doing relatively well in regard to achieving some independence in adulthood. However, 61% of the sample had outcomes that ranged from Poor or Very Poor. Lotter (1974) followed 32 individuals who were identified through an epidemiologic survey in Middlesex, England, when they were 8 to 10 years old. The mean IQ for these individuals in childhood was 71, with a range of 55 to 90. Eight years later, one person had passed away, and two were lost to follow-up. Sixty-two percent of those remaining were described as requiring "extensive care and supervision." Outcomes were rated as Good for only 14% and Poor or Very Poor for 60%.

Kobayashi, Murata, and Yoshinaga (1992) conducted a follow-up investigation of 201 adolescents and adults identified with ASD in childhood through clinical services in Japan. Four of the people had died. The mean age for the remaining 197 young adults was 21. About one-fourth of the sample had an IQ score of 70 or better at age 6, and about 20% were able to speak without echolalia at that age. Forty percent of the sample

began school in a general education class, but only 27% remained in general education at the age of 12. Outcome adjustment for roughly one-fourth of the sample was Good or better and was Poor or Very Poor for 46%. Childhood IQ was the only strong predictor of outcome in this investigation. Although there were similarities between the sample in this study and others reported, the outcome for these participants was better than in previous studies. The authors provided some possible explanations, including sociodemographic factors in Japan, advances in public education standards for people with disabilities, intensive intervention histories, and a high proportion of people with ASD and average-range IQ scores at baseline.

Howlin, Mawhood, and Rutter (2000) compared outcomes for 19 men diagnosed in childhood with autism. Participants were 7 to 8 years old at the time of the childhood assessment and were identified through their involvement in hospitals or special school programs in the community. They were 23 years, 9 months old on average at the time of the adult assessment. Roughly three-fourths of the men continued to exhibit severe social difficulties in adulthood. Only one-fourth were rated as exhibiting minimal or no "autistic-type behaviors." Just over half of the men relied on others to schedule and organize leisure activities for them, and one-third were described as having no or very limited interests or leisure activities. Three-fourths of the sample experienced a Poor or Very Poor outcome and 16% experienced a Good outcome or better. Analyses of childhood variables that were associated with adult functioning indicated that early language skills for these men were highly related to social functioning in adulthood.

Eaves and Ho (2008) followed 48 individuals with ASD from childhood to adulthood in Canada. Eight of the participants had a childhood IQ score above 70. All

participants received special education support in childhood, and 30% engaged in some kind of postsecondary educational program. Overall outcome adjustment ratings were that 21% had Good or Very Good outcomes, and 46% had Poor outcomes. Almost 80% received a government disability pension and used the services of social workers. Also in 2008, Cederlund et al. released their study of outcome for 70 adults with autism and 70 adults with Asperger Disorder. Twenty-seven percent of this sample obtained an outcome categorization of Good, and only two people fell within the Poor category. There were no participants with Very Poor outcome ratings.

Farley et al. (2009) studied 41 adults who had been identified through a population-based study of ASD in Utah in the 1980s. All of these individuals had historical IQ scores of 70 or greater. Mean age at the first assessment was 7 years and in adulthood was 32 years. Outcome adjustment was better for this sample than previous samples. No systematically collected prognostic factors could be found to explain the more positive outcomes, but anecdotal information suggested that the relative advantages experienced by the sample over others could be related to the social supports experienced by most of the sample, who were members of the Church of Jesus Christ of Latter-Day Saints (LDS Church) in Utah. LDS Church members tend to have large families and organize their religious communities according to the geographical location of their residences, so that in areas that contain a high-density of LDS Church members, children attend school and church activities with their neighbors. The members of individual congregations, therefore, tend to grow up having frequent interactions with the same community of individuals, with numerous interfamilial relationships due to family size. Participants in our sample routinely reported having found work, friendships, and roles in

social groups through their relationships with other members of their church group.

In a recent study of 20 U.S. adults first examined before 4 years of age, Gillespie-Lynch et al. (2012) analyzed outcomes at an average age of 26 years. This was the fourth data collection point from this sample, with others occurring at average ages of 11 and 18 years. On average, participants had an average mental age of 2 years when they were almost 4 years old and 8 years when they were 18 years old. There was a trend toward reduction in ASD symptoms and improvement in adaptive functioning scores over time. Outcomes were rated as Very Good or Good for 30% and Poor for 50%. Early childhood language ratings and IQ scores predicted adaptive functioning in adulthood for this sample. A unique strength of this study was the nature of systematic data collection in early childhood that included specific metrics on use of joint attention communication strategies. Initiation of joint attention, a voluntary communicative behavior, was not associated with adult variables, but response to joint attention, an involuntary communicative behavior, predicted adult social skills, ASD symptoms, and nonverbal communicative behavior.

The results of these studies indicate that outcome is almost always poor for individuals with childhood IQ scores of less than 70. For people with childhood IQ scores greater than or equal to 70, outcome is quite variable. Language ability at age 6 is also likely to be an important prognostic indicator, particularly for those who have relatively high IQ scores. However, within the group who demonstrate these abilities at a young age, there is little information about which additional characteristics may lead to greater adult independence and social success. Furthermore, as an additional area of concern, none of the previously mentioned studies collected information on the rates of

language regression in ASD or investigated the effects of language regression on long term adult outcomes.

The Proposed Study

Although there have been numerous studies separately investigating language regression in children, no study has had the longitudinal capabilities or data set to investigate the effects of language regression on adult outcomes. Furthermore, given the findings of Bilder et al. (2013) of heightened relationships between associated comorbidities and even mortality among individuals with ASD, it is important to investigate whether mortality rates differ as a function of language regression. This project conducts a comprehensive, prospective analysis of current adult functioning of individuals who were diagnosed with autism during childhood and reported to have language regression to those without reported language regression.

Research Questions

1. Using the initial Ornitz data, what are the regression rates, and will the percentage of individuals with reported language regression in the current sample be comparable to percentages reported in previous studies?
2. Are regression rates based on the ADI data comparable to the rates ascertained from the Ornitz data?
3. Do adaptive scores differ as a function of regression on the Ornitz?
4. Do outcome scores differ as a function of regression on the Ornitz?
5. Do outcome adjustment statuses (i.e., greater percentages in the Poor to Very

Poor categories) differ as a function of regression?

6. Do Full Scale, Nonverbal, and Verbal IQ scores differ as a function of regression?
7. Do gender composition and mortality rates exist or differ as a function of regression?

In summary, this study compared adult functioning for two groups of individuals who were diagnosed with autism during childhood: those who were reported to have language regression and those without language regression. Variables of interest included social participation, employment, and independent functioning, as well as IQ scores and adaptive skills.

Table 1

Rates of Regression by Study

Author (year)	*n* (autism/other ASD)	Rates of Regression (%)	Domains of Regression	Definition of Regression
Meilleur & Fombonne (2009)	135	22	Language and other skills	Normal use of skill for at least 3 month (the use of at least five communicative words other than "mama/dada" is required in the case of language loss) with substantial or complete loss for at least 3 months
Hansen et al. (2008)	333	41	Language and other skills	Normal use of skill for at least 3 month (the use of at least five communicative words other than "mama/dada" is required in the case of language loss) with substantial or complete loss for at least 3 months
Chistopher et al. (2004)	82	30	Language	Loss of consistent use of at least one word commonly used communicatively such as "mama" or "juice"
Lord et al. (2004)	96	25	Language	1. Loss of word: spontaneous use of at least three communicative words other than "mama/dada" daily for 1 month, followed by 1 month in which the child does not use any recognizable word 2. Fluctuating word loss: used at least three words daily for over a month followed by two periods of no words that lasted at least a month
Goldberg et al. (2003)	176	33	Language and other skills	Normal use of skill for at least 3 months (the use of at least five communicative words other than "mama/dada" is required in the case of language loss) with substantial or complete loss for at least 3 months
Taylor et al. (2002)	473	25	Language and other skills	Any deterioration in any aspect of the child's development or loss of skills as reported by the parent
Fombonne & Chakrabarti (2001)	194	17	Language and other skills	Normal use of skill for at least 3 month (the use of at least five communicative words other than "mama/dada" is required in the case of language loss) with substantial or complete loss for at least 3 months
Tuchman & Rapin (1997)	585	30	Language	Communicative use of at least three words followed by a loss of language for at least 3 months

Table 2

Summary of Literature on Outcomes as a Function of Language Regression in Early Childhood

Author (year)	***n***	**Age**	**Communication/ Language Skills**	**Adaptive/ Social**	**Autism Symptomatology**
Brown & Prelock (1995)	261	9–26 yrs	Difference	No Difference	N/A
Kobayashi & Murata (1998)	179	T1 mean: 6.89 yrs; T2 mean: 21.9 yrs	No Difference	No Difference	N/A
Davidovich et al. (2000)	40	7.06 yrs (mean)	Difference	No Difference	N/A
Lord et al. (2004)	110	2,3,4, and/or 5 yrs	No Difference	No Difference	Difference
Siperstein & Volkmar (2004)	573	7.9 yrs (mean)	No Difference	No Difference	No Difference
Werner et al. (2005)	72	3.6 yrs (mean)	No Difference	Difference	No Difference
Luyster et al. (2005)	351	4–15 yrs	Difference	Difference	N/A
Richler (2006)	351	4–15 yrs	No Difference	Difference	N/A
Bernabei (2007)	40	2,3,4,5,6 yrs	Difference	Difference	N/A
Hansen et al. (2008)	333	2–5 yrs	No Difference	Difference	N/A
Baird et al. (2008)	255	9–14 yrs	No Difference	No Difference	N/A
Giannotti et al. (2008)	104	2–6 yrs	N/A	N/A	Difference
Meilleur & Fombonne (2009)	135	6.3 yrs	N/A	N/A	Difference
Jones & Campbell (2010)	114	3.5 yrs	No Difference	No Difference	No Difference

Table 3

Outcome Categorization in Previous Studies

Study	Very Good *n* (%)	Good *n* (%)	Fair *n* (%)	Poor *n* (%)	Very Poor *n* (%)
Rutter, Greenfeld, & Lockyer (1967) (*n* = 63)	1 (2)	8 (13)	16 (25)	8 (13)	30 (48)
Lotter (1974) (*n* = 29)	n.a.	14 (48)	4 (14)	7 (24)	4 (14)
Kobayashi, Murata, & Yoshinaga (1992) (*n* = 201)	32 (16)	60 (31)	63 (32)	18 (9)	24 (12)
Howlin et al. (2004) (*n* = 68)	8 (12)	7 (10)	13 (19)	31 (46)	8 (12)
Eaves & Ho (2008) (*n* = 48)	2 (4)	8 (17)	15 (32)	22 (46)	0 (0)
Farley, McMahon, Fombonne et al. (2009) (*n* = 41)	10 (24)	10 (24)	14 (34)	7 (17)	0 (0)
Weighted mean	*11.85%*	*24.27%*	*28.08%*	*20.79%*	*14.8%*

CHAPTER 2

METHODS

Participants

Participants were recruited from the sample collected for the University of California Los Angeles (UCLA)-University of Utah Epidemiological Survey of Autism (hereafter referred to as the Epidemiological Survey), which occurred between 1984 and 1988 (Ritvo et al., 1990). As part of a 30-year follow-up study investigating autism into adulthood, identified participants from the Epidemiological Survey with documented early language regression were identified and eligible for this follow-up study examining early reported language regression on adult outcomes.

Selection Criteria – Epidemiological Survey

The survey procedure used in the Epidemiological Survey involved four stages of ascertainment of possible cases of ASD in individuals born between 1960 and 1984 (Ritvo et at., 1989). The four stages resulted in the identification of 489 participants including previously known cases of ASD, voluntary referrals in response to an extensive media campaign, referrals from community-based service providers, and cases resulting from records reviews of files at local service agencies. Diagnostic procedures consisted

of a three-tiered approach using DSM-III (1980) diagnostic criteria. In the first tier, blind examiners at UCLA independently reviewed historical and present symptom forms completed by families. Participants who did not meet criteria for AD were categorized "not autistic" at that time. Examiners met with remaining families for direct observation and developmental interviews during the second tier of diagnostic procedures. Participants who clearly met criteria were given a diagnosis at this point, and those who unequivocally did not meet criteria were offered appropriate referrals for further examination. In the third tier, participants who were still undiagnosed were examined again, and a diagnosis was established during a subsequent case conference in which consensus was reached among the team of examiners.

A total of 489 people were screened for autism. Of these, 241 were diagnosed with DSM-III autism, 138 were determined not to have DSM-III autism, and 110 were excluded from the study because they were out of the study age range, unwilling to participate, or contact was lost during the course of the study. At this time, investigators determined the rate of autism in this population to be 4 per 10,000, with an overall male to female ration of 3.7 to 1.0 (Ritvo et al., 1989).

Selection Criteria – Present Study

Contact information for individuals and their parents was obtained using public records databases, published telephone directories, and original contact information from the 1980s Epidemiological Survey. Detailed childhood records were located for 108 of the 138 participants who did not meet DSM-III criteria for autism and were excluded from the Epidemiological Survey. These 108 records were reviewed to investigate

whether the individuals would meet criteria for autism when using the DSM-IV standards. Using the Autism Diagnostic Observation Survey (ADOS) and Social Reciprocity Scale (SRS) scores, 64 (59%) of the 108 excluded participants with childhood records met criteria for autism using DSM-IV standards and thus were included in the current study. Letters of invitation to participate were mailed to potential participants and their parents of the original 241 participants that met DSM-III criteria and the 64 participants that met DSM-IV criteria (total $n = 305$). Two weeks after the anticipated delivery date, telephone contact was attempted for those who had not scheduled an appointment. One month after the first mailing, a second invitation was mailed, and a follow-up phone call was made 2 weeks following the expected date of the second mail delivery.

Thirty-year follow-up data for 172 adults were collected from the population based sample of 305 adults with ASD. Of the original Epidemiological Survey, data were collected for 172 participants, 31 participants declined participation, and 102 were lost to follow-up. Data on early childhood language regression were available from the childhood records for 118 out of the 172 participants in the follow-up study; see Table 4 for participant inclusion groupings. Language regression was determined using the applicable language questions in both the Ornitz and ADI interviews. See Appendix A for the language regression questions from the Developmental Inventory and Appendix B for language regression questions from the ADI. Any reported language loss (i.e., words, phrases, and statements) was recorded as language regression. Those individuals with no language loss reported or reported as "can't answer" or "I don't remember" were included in the group with no reported language regression; see Table 5 for participant's

reporting on the Ornitz.

Setting

The majority of the assessment procedures were conducted in participants' homes with the remainder performed at the Utah Autism Research Project offices. To the extent possible, participants with a previous diagnosis of autism were assessed concurrently with their caregivers.

Instruments

Assessment Tools in the Epidemiological Survey

The aim of the Epidemiological Survey was to identify all cases of autism in individuals born between 1960 and 1984 and living in Utah at the time of the survey. Direct observations, parent interviews, and records reviews were used to determine diagnostic status for each case. During the Epidemiological Survey, data regarding characteristics of infantile autism were collected using a modified version of the Behavior Observation Scale for Autism (BOS; Freeman et al., 1980) and a 500-item developmental inventory (Ornitz, Guthrie, & Farley, 1977).

Behavior Observation Scale for Autism (BOS)

The Behavior Observation Scale (Freeman, Schroth, Ritvo, Guthrie, & Wake, 1980) is an observation instrument that contains 67 items that objectively define behaviors in the areas of general behaviors, language, response to stimuli, attending response, response to being held, inappropriate response to pain, and motility disturbance

to stimuli. As one of the earlier scales used to define and examine groups, the BOS was developed with the ultimate goal of developing objective criteria for autism (Freeman et al., 1980).

Developmental Inventory

The Developmental Inventory developed by Ornitz (1977) is a written inventory completed by parents to report the presence or absence of associated pathological conditions for children with autism. Two versions of the inventory were developed for research, the Developmental Inventory for Children Seven-Years and Older, and a version for children 7 years and younger (Ornitz, 1977). The written inventory invites parents' responses, and reporters were encouraged to fill out the forms using any available aids such as baby books, photographs, and medical records. The Developmental Inventory compiles information ranging from pregnancy history to developmental motor milestones and language development, with several questions identifying early language regression. Neither of these tools was rigorously tested for psychometric properties; rather, they were used to collect pertinent information in a systematic fashion.

Information derived from these tools was the foundation of the diagnostic categorization "autistic" or "not autistic," in the DSM-III (1980, pp 89–90) criteria for Infantile Autism:

A. Onset before 30 months of age.

B. Pervasive lack of responsiveness to other people (autism).

C. Gross deficits in language development.

D. If speech is present, peculiar speech patterns such as immediate and delayed echolalia, metaphorical language, pronominal reversal.

E. Bizarre responses to various aspects of the environment, e.g., resistance to change, peculiar interest in or attachments to animate or inanimate objects.

F. Absence of delusions, hallucinations, loosening of associations, and incoherence as in Schizophrenia.

Assessment Tools in the Proposed Study

As part of a 30-year follow-up investigation, this study compared current adult functioning, gender, mortality, IQ, and adaptive scores for individuals who were diagnosed with autism as a function of whether they were reported to have early language regression. The follow measures were used to assess these variables.

Intelligence Tests

The Stanford-Binet Intelligence Scales, Fifth Edition (SB5; Roid, 2003), is an individually administered assessment of a person's intelligence and cognitive abilities and is appropriate for individuals age 2 and older. The test consists of verbal and nonverbal subtests that include activities such as defining words and solving puzzles. The three composite scores of the SB5 have been demonstrated to have internal reliability estimates of .95 and higher, with subtest reliabilities ranging from .84 to .89 (Roid, 2003).

The Wechsler Adult Intelligence Scale - Fourth Edition (WAIS-IV; Wechsler, 2008) is an individually administered, standardized test of a person's intellectual ability and cognitive strengths and weaknesses and is appropriate for individuals 16 years and

older. The test consists of verbal and nonverbal subtests that include activities such as defining words and solving puzzles. The four index scores of the WAIS-IV have internal reliability estimates of .80 and higher, with subtests reliabilities ranging from .55 to .88. Test reliabilities range from .84 to .89 for different age groups (Glass, Ryan, & Charter, 2010).

Vineland Adaptive Behavior Scales, Second Edition (Vineland-II)

The Vineland-II (Sparrow, Cicchetti, & Balla, 2005) is a survey tool used to measure a person's adaptive level of functioning and is organized into three domain structures: Communication, Daily Living, and Socialization, and an Adaptive Behavior Composite score. The Vineland is useful in assessing an individual's daily functioning skills, how one interacts within their own environment, and everyday living skills, such as preparing a meal, getting dressed, going to work, etc. Additionally, the Vineland-II aids in diagnosing and classifying intellectual and developmental disabilities, such as autism. The Vineland-II in the form of a questionnaire is used to assess adaptive behavior from birth to adulthood and is administered in a semistructured interview format, taking approximately 20 to 60 minutes to complete. The domain scores of the Vineland-II have internal reliability estimates of .83 and higher, with the Adaptive Behavior Composite scoring at .94. Test-retest reliabilities range from .81 to .86, and interrater reliabilities range from .62 to .78 on the domain scores and .74 on the Adaptive Behavior Composite (Sparrow et al., 2005).

Social Responsiveness Scale (SRS)

The SRS (Constantino, 2002) is a 65-item rating scale that can be used to measure social impairments in individuals with autism and in typically developing individuals as they occur in natural settings. This instrument helps in providing a clear picture of an individual's social impairments by assessing social awareness, social information processing, capacity for reciprocal communication, social anxiety/avoidance, and autistic preoccupations and traits. The SRS can be used to assess individuals between the ages of 4 and adulthood and is completed by a primary caregiver or someone who has known the participant for at least 6 months. It can typically be completed in 15 to 20 minutes. Total score reliability estimates are reported to be above .90. Subscale reliability estimates range from .76 to .85 for males and females rated by parents and teachers. Two-year, test-retest reliability has been estimated at .83 (Constantino et al., 2003). Previous research has shown that social deficits on the SRS are continuously distributed and that the SRS reliably distinguishes children with an autism spectrum disorder from those with other psychiatric disorders (Constantino & Todd, 2000).

Autism Diagnostic Interview, Revised (ADI-R)

The ADI-R (Rutter et al., 1994) is a semistructured interview consisting of 89 items that are administered to the primary caregivers of children who potentially have autism. The ADI-R relies heavily on caregiver descriptions of development in the areas of language, communication, social interaction, and restricted, stereotyped, and repetitive behaviors. Current and past behaviors are coded; therefore, items assessing abnormal behaviors are scores for both the current state of the behavior and past expressions of the

behavior. Items are subdivided into three domains according to three sets of diagnostic criteria that must be met for a diagnosis of autism: (a) qualitative abnormalities in reciprocal social interaction, (b) qualitative abnormalities in communication, and (c) restricted, repetitive, and stereotyped patterns of behavior. Reported interrater reliability estimates for the ADI-R range from .52 to .95 (Rutter et al., 1994). As indicated previously, the ADI specifically investigates language regression in the Communication domain with sections of the checklist targeting "the level of communicative language before loss/loss of language skills after acquisition." Several of the language questions also have codes that provide responses that include language regression: "has some words, then lost." See Appendix B for communication and language questions pertaining specifically to language regression on the ADI.

Autism Diagnostic Observation Schedule, Generic

The Autism Diagnostic Observation Schedule-Generic (ADOS; Lord et al., 2003) is a semistructured, developmentally based, standardized assessment of social and communication deficits generally associated with autism. The ADOS is comprised of standard activities that allow for the observation of behaviors that have been identified as important in diagnosing autism spectrum disorders at different developmental stages. The ADOS consists of four modules, all of which can be administered in 30 to 40 minutes. Reported interrater reliability estimates range from .84 to .93, and test-retest reliability estimates range from .73 to .82. The ADOS has been used to detect significant differences between individuals with and without autism (Lord et al., 2000).

Formulation of Outcome Status

A composite rating on a 5-point scale (See Table 6) of overall social and independent living functioning, ranging from "Very Poor" to "Very Good," was based on the outcome formulation guidelines investigating work status, residential situation, and number and quality of friendships (See Appendix C; Howlin, Goode, Hutton, & Rutter, 2004). Specific rating criteria from the ADI and other collected information (ADI; Le Couteur et al., 1989) were used to define work status, friendships, independence, and current language usage.

Procedure

The ethical principles of the American Psychological Association (2002) informed treatment of all participants. Furthermore, the study was approved by the University of Utah's Institutional Review Board for the Protection of Human Subjects, the Institutional Review Board of the Utah Department of Human Service, and the Research Committee of the Utah State Developmental Center (see Appendix D).

A letter was sent to the mailing address on file for all potential participants. The letter described the rationale for the outcome study, the procedures involved in participation, and benefits of participation. This letter also extended an invitation to families to contact the principal investigator for more information and scheduling. Families who did not respond within 2 weeks of the mailing were contacted by phone and invited to participate. The assessment protocol was designed to maximize the likelihood of completion within a single appointment lasting approximately 4 hours. Families requesting multiple appointments in order to reduce possible strain associated with a single visit were accommodated, with subsequent appointments scheduled within 2

weeks to the extent possible.

Participants were assigned a subject identification number to which all data were linked. Except for birth date, which is required for scoring the cognitive and adaptive measures, all personal identifiers were removed from the data. A key linking the subject identification codes to the participant's personal information was retained in a secure location in the Utah Autism Research Program's suite.

Participants were provided with a brief schedule and description of the activities they were asked to engage in during the appointment, prior to the initiation of any assessment procedure. The principal investigator or a trained research assistant (a doctoral student in the university's school psychology or clinical psychology programs and employed by the Utah Autism Research Program) conducted the observation-based assessment of autistic characteristics (ADOS) and the cognitive assessment (WAIS-III, WAIS-IV, SB-V). When possible, the diagnostic (ADI), adaptive behavior (Vineland), and brief outcome interviews were conducted concurrently. The principal investigator or a trained research assistant administered these interviews. Administration of all measures occurred in a standardized manner in accordance with the procedures dictated for each instrument. Administration of all measures also took place under the supervision of a licensed psychologist.

Participants were observed for signs of fatigue during the assessments and were offered refreshments and opportunities for breaks. A meal was provided to participants whose appointments approached or overlapped lunch or dinner hours. All participants were given $50 in compensation for their time and travel. In addition, participants (or their legal guardians) received a written report of the individual results of their research

assessment.

The principal investigator or trained research assistant scored all protocols. Outcome categorization was assigned by the principal investigator and by a trained research assistant to assess interrater reliability. Initial ratings were consistent for 95% of the scores, and a subsequent discussion resulted in resolution of disparities to achieve consensus. Assessment data were entered into a secure database, linked only to the participant identification number. Data entry was checked for accuracy a total of three times.

Design

Broadly, this study was part of an investigation that used a longitudinal research design in the comparison of data obtained in the Epidemiological Survey against results of current assessments. However, the research questions raised in this study represent one of several small studies that employ different types of designs to investigate adult outcomes 30 years after the initial diagnoses relating to autism and language regression.

Data Analyses

The frequency of language regression was calculated for the sample using the Ornitz and ADI. *T* tests assuming equal variance were used to compare means between individuals with and without language regression for all measures. Chi-Square goodness-of-fit tests were used to test for differences in reported language regression in the ADI and Ornitz, gender composition, and mortality rates between individuals with and without language regression. An ANOVA was used to investigate Time-1 and Time-2 Full Scale

IQ scores as a functioning of language regression with the participants that had both cognitive measures.

Table 4

Participant Inclusion Groups

	n
Total	305
Epidemiological Survey	241
Reclassification Study	64
Declined	31
Lost to Follow-Up	102
Collected	172
Recorded Language Regression Data (based on the Ornitz)	118

Table 5

Language Regression Reporting on the Ornitz

	Lang. Reg. Reporting on the Ornitz		
	#5-71, 72*	#7-75, 76*	#5-79, 80*
	n (%)	*n* (%)	*n* (%)
Month of Occurrence (incl. in lang. reg. group)	26 (22)	11 (9)	6 (5)
Occurred, But Can't Remember When (incl. in lang. reg. group)	12 (10)	5 (4)	0 (0)
Never Occurred (incl. in non lang. reg. group)	12 (10)	13 (11)	6 (5)
Can't Remember (included in non lang. reg. group)	68 (58)	89 (75)	106 (90)

* See Appendix A for Regression Questions from the Ornitz

Table 6

Outcome Categories

Category	Definition
Very Good	Achieving a high level of independence, having some friends and a job
Good	Generally in work but requiring some degree of support in daily living; some friends/acquaintances
Fair	Has some degree of independence, and although requires support and supervision, does not need specialist residential provision; no close friends but some acquaintances
Poor	Requiring special residential provision/high level of support; no friends outside of residence
Very Poor	Needing high-level hospital care; no friends; no autonomy

CHAPTER 3

RESULTS

Diagnostic Stability

Thirty-year follow-up data for 172 adults were collected from the population based sample of 305 adults with ASD. Of the original Epidemiological Survey, data were collected for 172 participants, 31 participants declined participation, and 102 were lost to follow-up; see Table 4 for the participant group numbers.

Data on early childhood language regression were available from the childhood records for 118 of the 172 participants in the follow-up study. Of the 118 participants with early childhood regression data, ADIs could only be conducted on 29 of the participants, thereby providing a second measure of early reported language regression for a small portion of the sample. Vineland measures identifying communication, daily living, social skills, and adaptive skills were collected for 95 participants. Childhood (Time-1) Full Scale IQ scores were available for 94 of the participants with language regression; however, adult (Time-2) Full Scale IQ scores were only attained for 37 participants. Any adult IQ scores that were unable to be collected were due to noncompliance, presenting as untestable or deceased. Of the 118 participants collected for this sample with early language regression data, 17 were deceased. Adult outcome

scores were tabulated for 99 of the living participants. See Table 7 for collected measures.

Language Regression

Of the 118 participants with Ornitz language regression data, 66% (n = 79) did not have reported language regression, leaving 34% (n = 40) with reported language regression. These percentages are comparable to the previously mentioned studies investigating rates of regression, in which rates ranged from 17% to 41% (see Table 1). Of those participants with language data reported on the ADI (n = 29), 17% (n = 5) had reported language regression, leaving 83% (n = 21) without reported language regression (see Figure 1). Using the ADI language regression data, the reported rates of language regression commensurate and also fall (although only just barely) within the previously reported ranges of language regression.

Only 29 participants had both Ornitz and ADI language regression data. To determine and test for measures of interrater agreement, a chi-square analysis was run to compare consistency of reported rates of regression on the Ornitz and ADI. Three participants were reported with language regression on both the Orntiz and ADI, and 15 participants had consistent scores on both measures reporting no language loss. Two participants were rated as having language regression on the ADI, but not on the Ornitz. Nine participants were rated as having no language loss on the ADI, but reported as having language loss on the Ornitz. See Table 8 for language regression scores on both checklists. A chi-square analysis indicated marginal significance ($\lambda_1^2 = 3.72$, $p = .05$) between rater agreement on the Ornitz and ADI, suggesting that the two measures differ

in the ways in which they assess language regression. As previously mentioned, for this study, language regression was determined using the relevant language questions on the ADI and Ornitz interviews. Any reported language loss (i.e., words, phrases and statements), regardless of age of occurrence, was counted in the language regression sample. Those with no language loss or responses such as "can't answer" or "I don't remember" were combined into the no language regression sample. Of the Ornitz sample with no reported language regression, 16% (n = 13) fell in that group due to not being able to answer or remember occurrences of language regression. While the majority of raters (n = 28) were able to report exact ages of loss in one area of language development, consistent information was not provided on the Ornitz regarding when language loss occurred across the three items. Due to the limited data and inconsistent information including the exact age/month of regression dates, an age component investigating language milestones or comparison of language loss, as a function of age, was unable to be calculated. Furthermore, since the ADI regression data were limited due to sample size (n = 29), all analyses were based solely on the Ornitz language regression data, unless noted.

Adaptive Behavior

Scores on the Vineland Adaptive Behavior Scales – Survey Edition were obtained for 95 participants in the Communication, Daily Living, Socialization, and Adaptive Skills domains. Comparisons of the scores for participants with and without language regression showed no significant differences in any of the domain areas; see Figure 2 for adaptive scores by language regression. The difference between participants with and

without regression in the Communication domain was not significant (t_{93} = .47, p = .64), suggesting no significant differences in areas of receptive, expressive, and written communication skills between those with and without language regression. The difference between for participants with and without regression in the Daily Living domain was not significant (t_{93} = 1.11, p = .27), suggesting no differences between measures of personal behavior as well as domestic and community interaction skills as a function of language regression. The difference between participants with and without language regression in the Socialization domain was not significant (t_{93} = -.42, p = .67), indicating areas related to play and leisure time, interpersonal relationships, and various coping skills did not differ between the groups who had and had not experience language regression. The difference between the participants with and without language regression for the Adaptive Skills domain was also not significant (t_{93} = .38, p = .70), suggesting no differences as a function of language regression in areas related to social and personal behavior and interactions within one's environment. See Table 9 for mean scores for each adaptive domain as a function of language regression.

Social Functioning and Outcome Ratings

Howlin et al. (2004) devised a method for estimating overall social outcome by combining ratings for friendships, work, and independent living. Several measures were used to obtain information and were considered when assigning ratings. Parents or caregivers were asked a series of questions concerning their adult son or daughter's friends, membership in organized groups, and romantic relationships, in addition to the questions on the ADI (when available) and Vineland Survey. Outcome measures were

obtained for 99 participants; see Figure 3 for scores of social functioning as a function of language regression. Seventeen participants were deceased upon follow-up and were not assigned adult outcome scores and two participants had incomplete data and were unable to be reached after follow-up to complete adult outcome formulations. The difference between participants with and without language regression for the Work domain was not significant (t_{97} = -.46, p = .65), suggesting no significance differences were found in work/employment status between individuals with autism that did and did not experience language regression. The difference between participants with and without language regression for the Friendship domain was also not significant (t_{97} = .14, p = .89), suggesting that language regression did not have an impact on friendships. No significant differences were detected between participants with and without language regression for the Independence domains (t_{97} = .03, p = .98), demonstrating no significant difference in independence as a function of language regression. The difference between the participants with and without language regression was also not significant for the composite of Social Functioning (t_{97} = .90, p = .37), showing that reports of language regression did not significantly impact overall level of social functioning. As previously documented, the Outcome Total scores were used to formulate the Social Functioning Composite ratings and are detailed in the next section. See Table 10 for mean outcome variable scores as a function of language regression.

Social Functioning Composite Ratings

As previously stated, outcome measures were obtained for 118 participants. Seventeen participants were deceased upon follow-up and were not assigned adult

outcome scores, and two had missing data that were unable to be recovered, resulting in 99 participants with Overall Social Functioning scores. Only four individuals (5.71%) with no language regression and none (0%) with language regression fell within the "Very Poor" categorization, indicating a need for a high level of hospital care, no friends, and no autonomy. Twenty-eight (40%) who did not experience language regression and 15 participants (51.72%) who did experience language regression fell into the "Poor" outcome category, suggesting that they were under supervision during much of their daytime and leisure activities, required a high level of support from others, and they had no friendships outside of their home environment. Of the participants that ranked in the "Fair" outcome category, indicating the need for supervision in the home and work settings or that they were unemployed without regular daytime activities, 23 (32.86%) did not have language regression and nine (31.03%) participants did experience language regression. These individuals typically did not have individuals they preferred to spend time with outside of structured activities like work or church times. Eight (11.43%) participants who did not experience language regression and three (10.34%) participants who were reported to have language loss fell into the "Good" outcome category, meaning that they did not live independently, but did have a high level of independence in their daily lives, had some form of paid employment, and had at least one friend or some acquaintances with whom they interacted regularly. Finally, seven (10%) individuals who did not experience language regression and two (6.90%) individuals who did experience language loss fell within the "Very Good" category, suggesting a high degree of independence, some friendships, and paid employment; see Figure 4 for outcome categories as a function of language regression. A chi-square analysis was run to

investigate differences across the outcome statuses as a function of regression. No differences were found between any of the outcome categories ($\lambda_4^2 = 2.57$, $p = .63$), demonstrating that language regression has limited utility as a variable that predicts or influences adult outcomes for individuals with autism. See Table 11 for mean overall outcome values as a function of language regression.

Due to small group sizes in some of the outcome categories, outcome measures were combined. The "Very Poor" and "Poor" outcome categories were combined into a single group, the "Fair" remained the same, and the "Very Good" and "Good" outcome categories were combined into one group, see Figure 5 for combined outcomes ratings results.

Thirty-two (45.71%) participants who did not experience language regression and 15 participants (51.72) who did experience language regression fell within the "Very Poor" and "Poor" outcome categories. Again, of the participants that ranked in the "Fair" outcome category, 23 (32.86%) did not have language regression and 9 (31.03%) participants did experience language regression. Fifteen (21.43%) participants who did not experience language regression and five participants who did experience language regression fell in the "Good" and "Very Good" outcome categories. Even when some categories were collapsed, no statistically significant differences existed between combined outcome statuses as a function of regression ($\lambda_2^2 = .19$, $p = .91$). See Table 11 for mean combined outcome values as a function of language regression.

Cognitive Abilities as a Function of Regression

Childhood or Time-1 Full Scale IQ scores were available for 94 participants out of the 118 with early language regression data, and adult or Time-2 Full Scale IQ scores were available for only 37 participants. In the adult (Time-2) cognitive measures, Nonverbal and Verbal IQ scores were also calculated; see Figure 6 for graph on cognitive scores by language regression groups. An ANOVA was used to investigate Time-1 and Time-2 Full Scale IQ scores as a functioning of language regression with the participants that had both cognitive measures, and a chi-square analysis to investigate participants with and without language regression and IQ scores above and below 70 points; see Figure 7 for graph featuring cognitive abilities below and above 70.

Results indicate no significant effect of time ($F(1,30) = 1.33$, $p = .26$), no significant effect of language regression ($F(1,30) = 1.86$, $p = .18$) and no interaction between the two variables, $F(1,30) < 1$. Planned comparisons demonstrated that the difference at Time-1 between the participants with and without regression on Full Scale IQ was significant ($t_{92} = -2.23$, $p = .03$); participants with early language regression had lower IQ scores than those participants without language regression. However, the difference at Time-2 between participants with and without regression on the Full Scale IQ was not significant ($t_{35} = -1.17$, $p = .25$), indicating that early language regression did not significantly impact overall cognitive abilities 30 years later. The difference at Time-2 between individuals with and without language regression was also not significant for either of the IQ subscales: Nonverbal IQ ($t_{36} = -.99$, $p = .33$) or Verbal IQ ($t_{35} = -.63$, $p = .53$). This suggests that the nonverbal and verbal cognitive abilities of participants with autism and early reported language regression did not significantly differ. See Table 12

for Subject IQ Characteristics.

An additional chi-square analysis was conducted to investigate if there was a difference between occurrences of language regression and participants with Full Scale IQ scores below and above 70 points. This analysis was run to investigate if language regression interacts with cognitive functioning. Analysis showed there were different distributions of language regression with participants who had Time-1 Full Scale IQ scores above and below 70 points ($\lambda_1^2 = 4.92$, $p = .027$). Participants with language regression also had lower Full Scale IQ scores at Time-1.

Gender and Mortality

Within the study there were 22 female participants and 96 male participants. Seventeen (77.27%) female and 61 (63.54%) male participants did not experience language regression. Five (22.73%) females and 35 (36.46%) male participants were reported to have language regression; see Figure 8 for gender histogram. A chi-square analysis was run to determine gender differences as a function of language regression, but again this did not yield any significant differences ($\lambda_1^2 = 1.51$, $p = .22$).

Of those participants with early language data, seven (8.97%) individuals with no reported language regression and 10 (25.0%) individuals with reported language regression have passed away since their initial evaluation with the Epidemiological Study; see Figure 9 for a mortality histogram. A chi-square analysis was run to determine mortality rate differences as a function of regression, which was significant ($\lambda_1^2 = 5.51$, $p = .02$), indicating that a higher mortality rate existed for those with early reported language regression.

Table 7

Measures by Sample Size

Measure	Subjects
Ornitz	*n* = 118
ADI	*n* = 29
Vineland	*n* = 95
Outcome Categorization	*n* = 99
Childhood (Time-1) Full Scale IQ	*n* = 94
Adult (Time-2) Full Scale IQ, Nonverbal and Verbal IQ	*n* = 37

Table 8

Number of Individuals With and Without Language Regression as Measured by the Ornitz and ADI

		ADI	
		No Loss	Loss
Ornitz	No Loss	15	2
	Loss	9	3

Table 9

Mean Adaptive Scores as a Function of Domain and Language Regression

	No Language Regression		Language Regression	
	Mean	*SD*	Mean	*SD*
Vineland - Communication	35.51	24.26	38.37	31.76
Vineland – Daily Living	42.57	27.30	50.22	36.56
Vineland - Social	38.18	26.43	35.56	29.28
Vineland - Adaptive	37.09	24.75	39.44	32.02

Table 10

Mean Scores for Outcome Variables as a Function of Language Regression

	No Language Regression		Language Regression	
	Mean	*SD*	Mean	*SD*
Outcome - Work	2.04	1.12	1.93	1.06
Outcome – Friendships	2.14	.91	2.17	1.00
Outcome – Level of Independence	2.54	1.30	2.55	1.45
Outcome – Total Score	6.73	2.72	6.69	2.67
Outcome – Overall Social Functioning	2.23	1.02	2.45	1.27

Table 11

Mean Overall Outcome Values as a Function of Language Regression

	No Language Regression	Language Regression
	n (%)	*n* (%)
Outcome – Very Poor	4 (5.71)	0 (0)
Outcome – Poor	28 (40.00)	15 (51.72)
Outcome – Fair	23 (32.86)	9 (31.03)
Outcome – Good	8 (11.43)	3 (10.34)
Outcome – Very Good	7 (10.00)	2 (6.90)
Outcome (Combined) – Very Poor/Poor	32 (45.70)	15 (51.72)
Outcome – Fair	23 (32.86)	9 (31.03)
Outcome (Combined) – Good/Very Good	15 (21.43)	5 (17.24)

Table 12

Mean Full Scale IQ, Verbal IQ, and Nonverbal IQ Scores as a Function of Language Regression

	No Language Regression		Language Regression	
	Mean	*SD*	Mean	*SD*
Full Scale IQ – Time 1	64.76	26.63	52.79	21.69
Full Scale IQ – Time 2	73.39	29.28	61.00	21.69
Nonverbal IQ – Time 2	73.59	32.74	61.89	23.05
Verbal IQ – Time 2	72.00	30.89	64.89	23.25

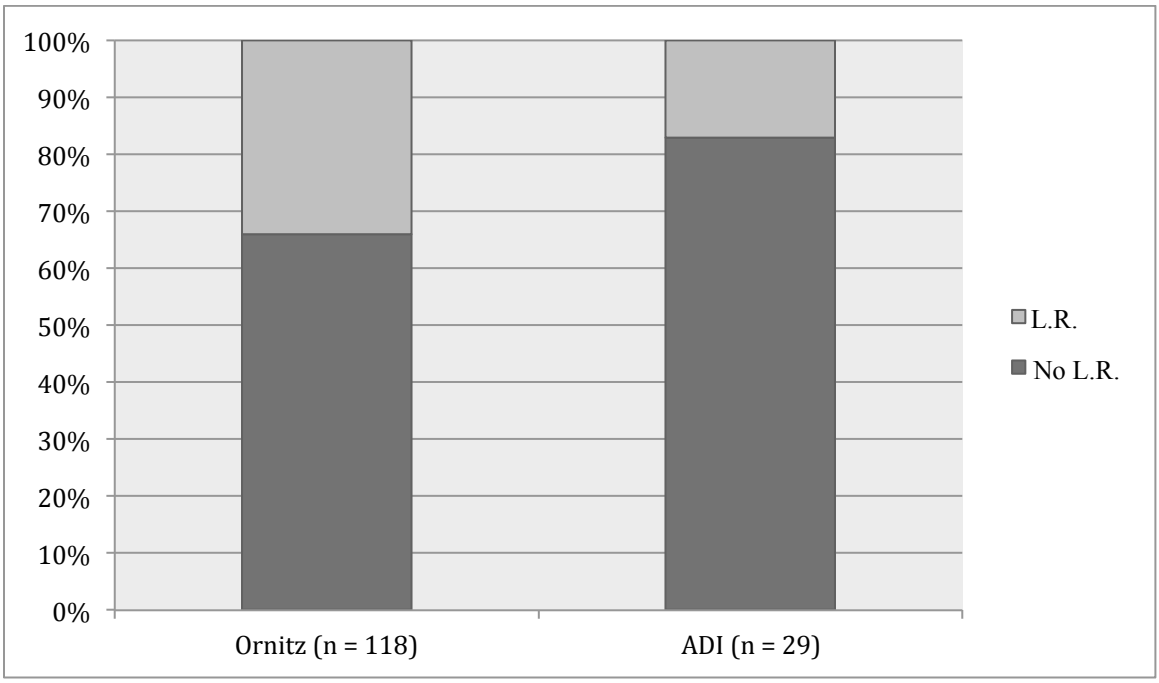


Figure 1

Language Regression Rates as a Function of Measurement Tool

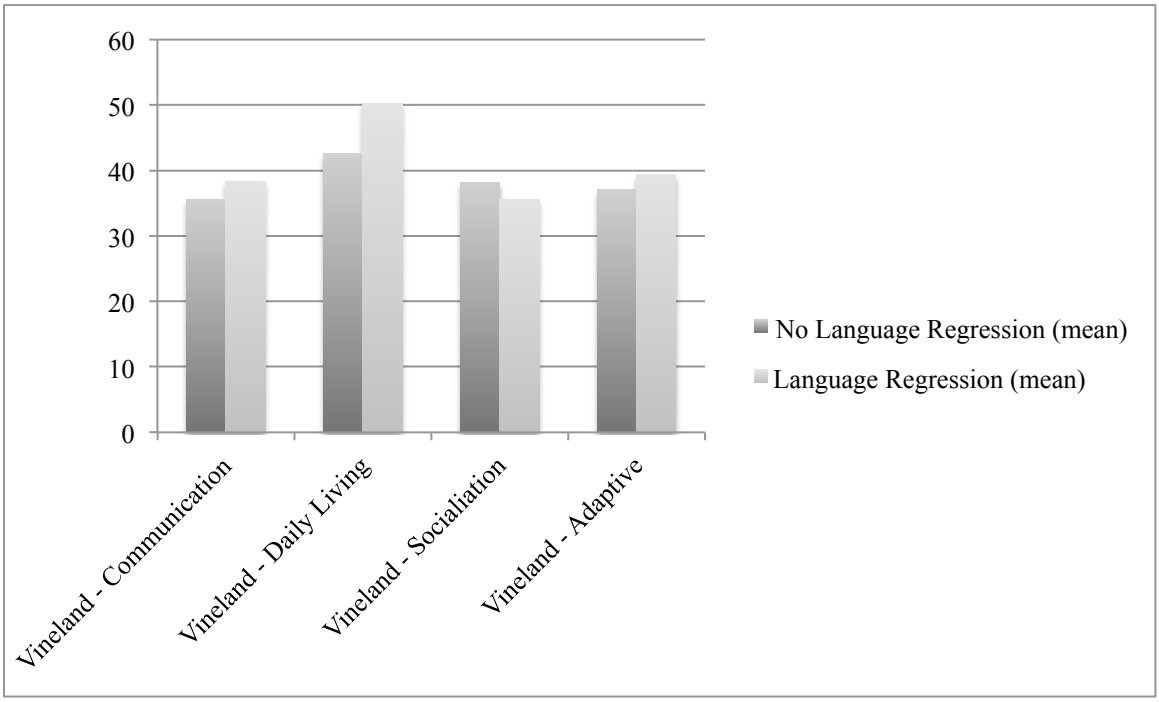


Figure 2

Mean Scores of Adaptive Behavior as a Function of Language Regression

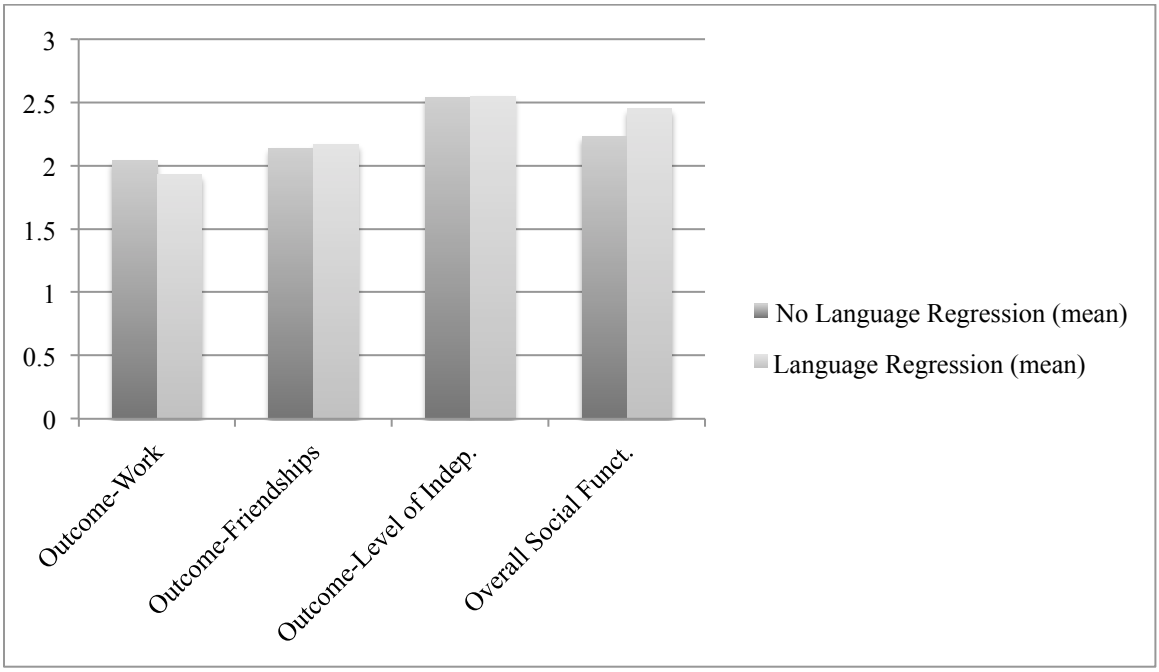


Figure 3

Mean Scores of Social Functioning as a Function of Language Regression

Figure 4

Percentages of Individuals in Each Outcome Category as a Function of Language Regression

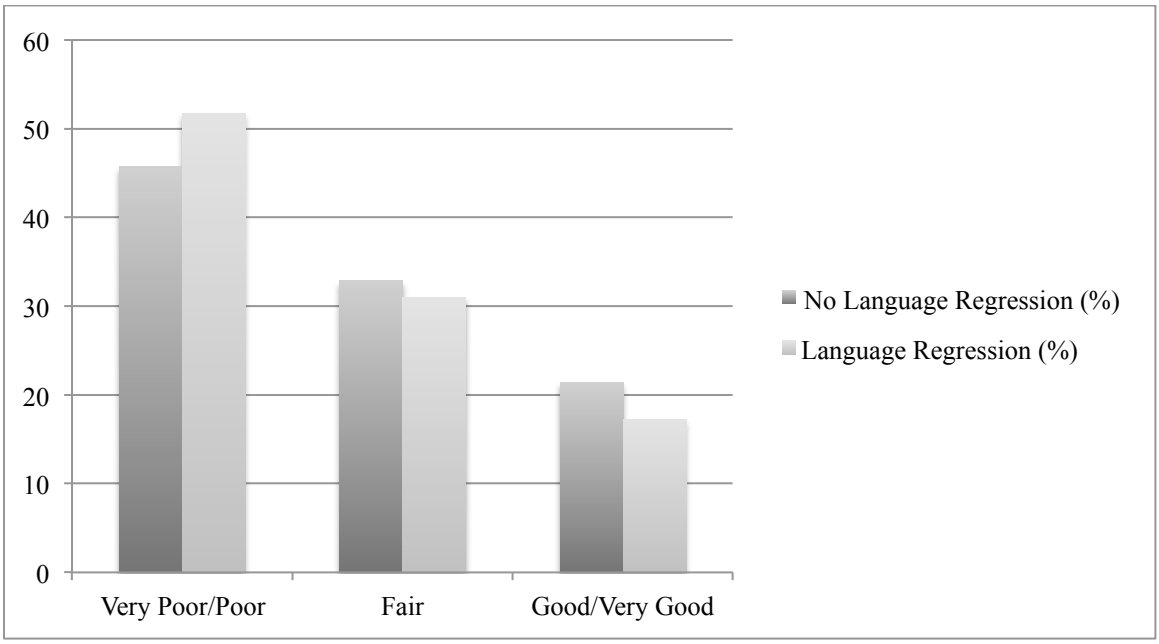


Figure 5

Percentages of Individuals in Combined Outcome Categories as a Function of Language Regression

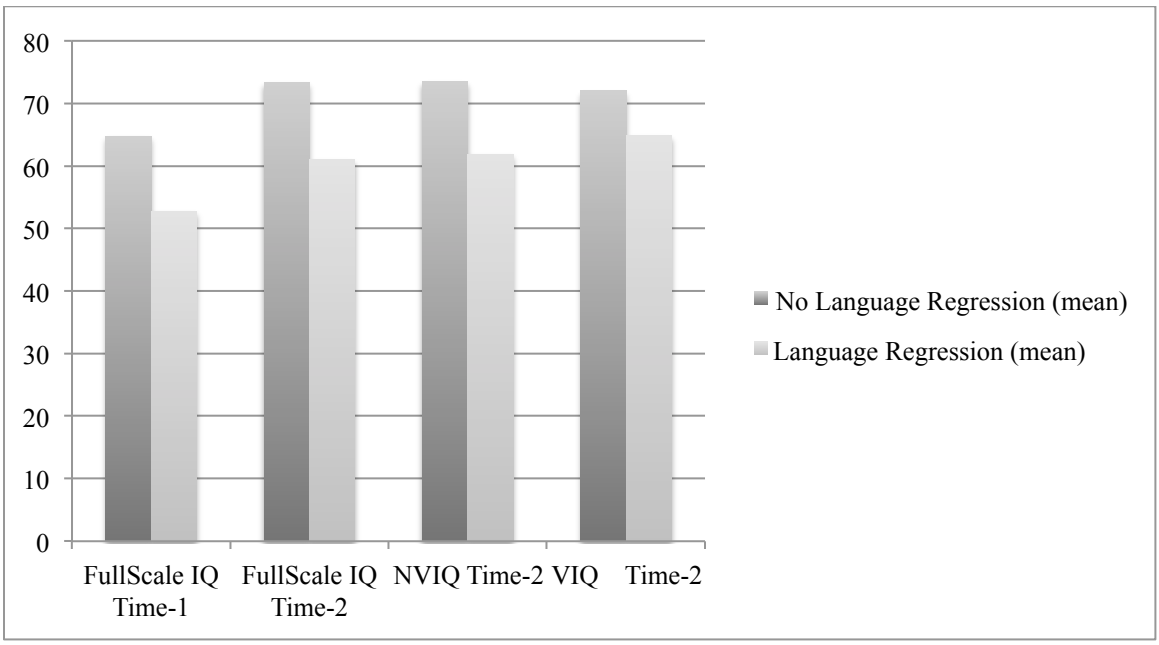


Figure 6

Mean IQ Scores as a Function of Time and Language Regression

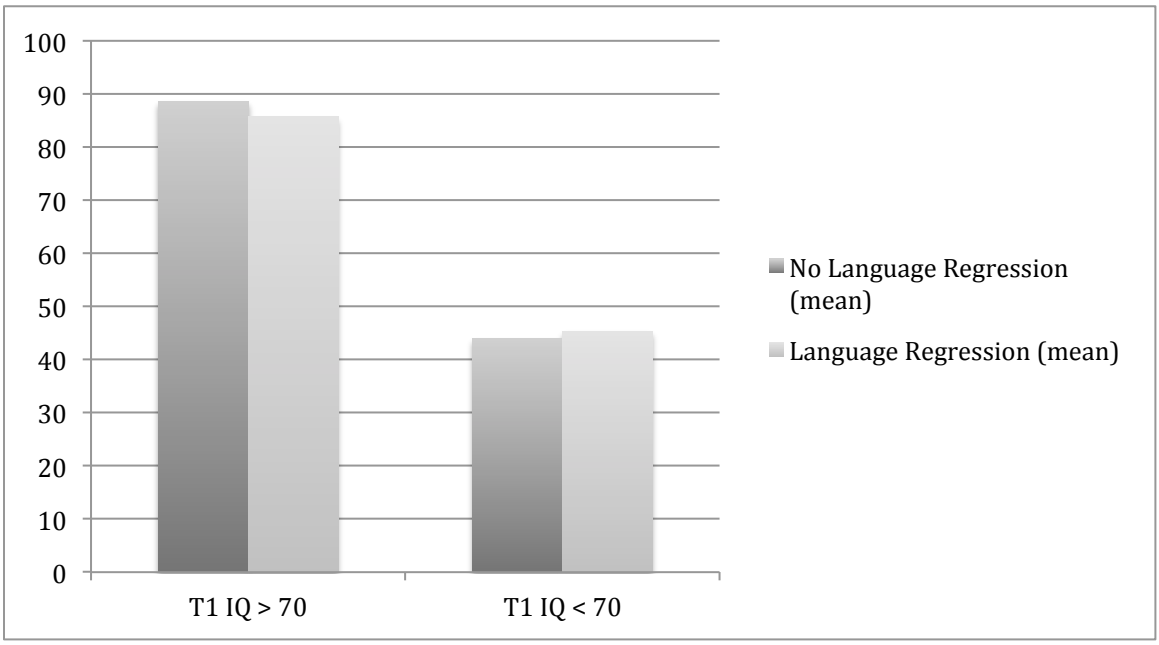


Figure 7

Mean IQ Scores Split Above/Below 70 and as a Function of Language Regression

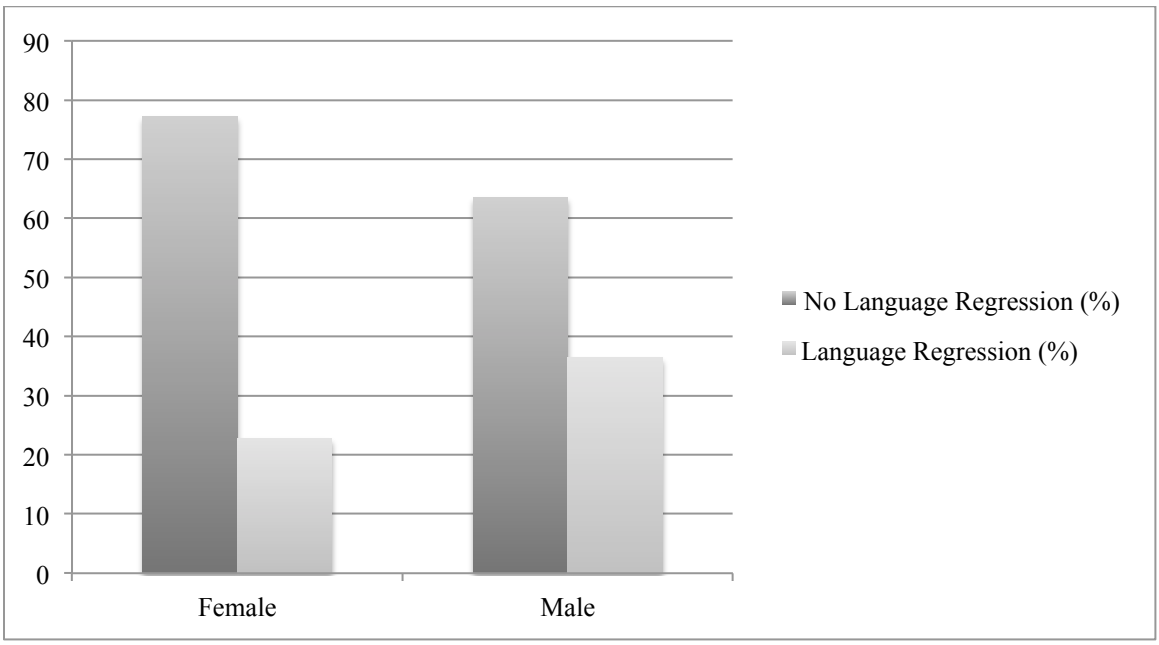


Figure 8

Gender Distribution as a Function of Language Regression

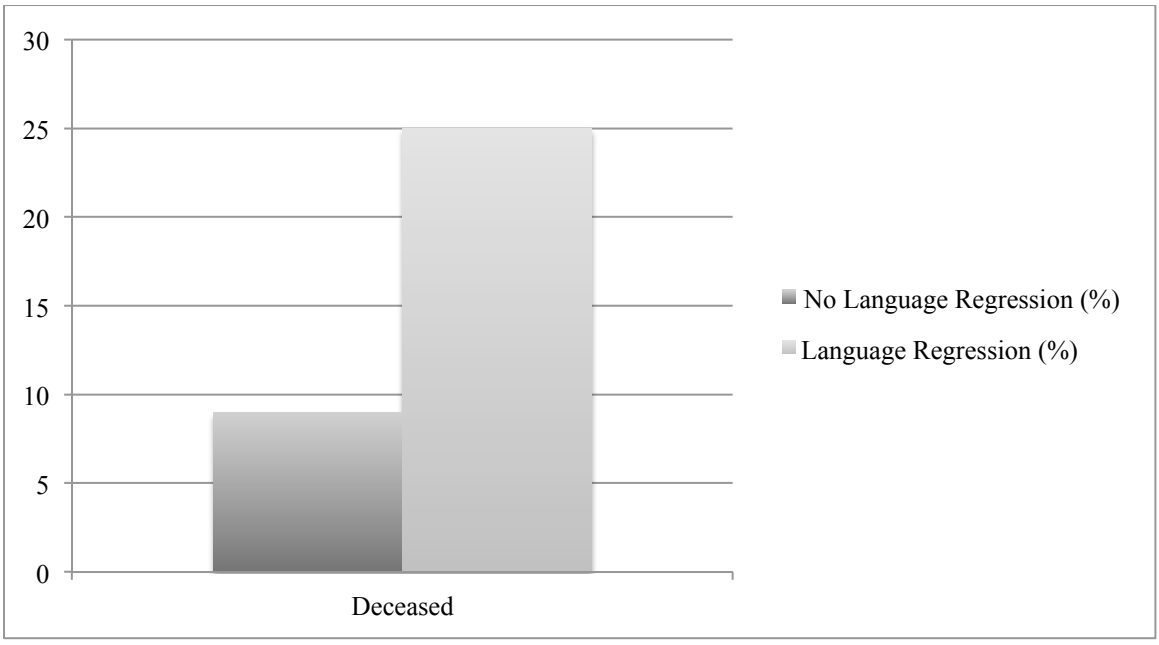


Figure 9

Mortality Rates as a Function of Language Regression

CHAPTER 4

GENERAL DISCUSSION

Research regarding adult outcomes is critical and much needed in order to improve our understanding of prognostic factors, outcome characteristics, and services needed for adults with ASDs. Therefore, examining any and all variables associated with ASD, such as language regression, benefit all those affected. Several studies have compared the outcomes of children with and without language regression; however, no studies to date provide outcome data investigating the early effects of language regression on adult outcomes.

Access to historical records from the 1980s Epidemiological Study allowed for analyses of changes in variables and the predictive utility of measures over time as a function of language regression. To date, no other study has had 30-year outcome data in order to investigate adaptive, cognitive, and outcome variables as a function of language regression. Many studies have investigated the short-term effects of language regression on communication, symptomatology, and adaptive skills, but only over maximum ranges of 6 years, thus disregarding the potential long-term effects.

Rates of Language Regression

Rates of regression on both the Ornitz and ADI interviews were commensurate with all previous studies that have suggested that rates of language regression vary from 17% to 41% (see Table 1) of the population of individuals with ASD. In this study, participants with language regression on the Ornitz comprised 34% of the sample, and participants with regression on the ADI made up 17% of the sample; these rates of regression are comparable to those reported in previous studies investigating language regression. Overall, though, rates of regression in the research literature vary due to differing definitions of regression and reporting methods (i.e., parent report, doctor report, caregiver report, etc.). In this project, rates of childhood language regression were compared on a small subset of the participants (n = 29) using two different measures: the Ornitz and ADI. The analysis, although only marginally significant, indicated that the two measures differed in the ways in which they assess language regression and that the intermeasure reliability was poor. Many of the individuals participating in this 30-year longitudinal study no longer had parents as their caregivers, resulting in raters who had not known the subjects their entire lives, which may have compromised accurate reporting of their childhood events. Furthermore, recall of a child's language regression, and exactly when it occurred, is likely to be considerably easier when they are still children, rather than 30 years later when memories and recollections may be altered or forgotten. Had the ADI been given back then during the Epidemiological Survey, it could be presumed to be a reliable and more direct measure; however, given as a 30-year retrospective measure, the ADI in this project did not yield results consistent with the Ornitz data.

Adaptive Behavior and Language Regression

Many previous researchers have suggested that language regression can have negative impacts on adaptive behavior (Bernabei, 2007; Hansen et al., 2008; Luyster et al., 2005; Richler, 2006;Werner et al., 2005); however, in this study, comparisons of the scores for participants with and without language regression yielded no significant differences in any of the domain areas. Previous research by Werner et al. (2005) and Richler et al. (2006) found social reciprocity to be more impaired for children with regression versus the nonregressed comparison group, and Hansen et al. (2008) reported that children with ASD who had experienced regression had poorer adaptive communication skill. However, while research to date shows varying results regarding the effect of language regression, no previous study has focused on a longitudinal data such as the one used here to assess the long-term lasting effects and outcomes of language regression on adaptive behaviors. For example, both Bernabei (2007) and Lord et al. (2004) found differences in communication/language skills, adaptive skills, and autism symptomatology; however, their longitudinal measures where taken at ages 2, 3, 4, 5, and 6. Differences as a function of regression at these early ages is likely to be much more noticeable than after 30 years, when many children potentially "catch up" developmentally. Overall, while research suggests inconclusive and varying results regarding language regression and its impacts, the results of this longitudinal study suggest that time abates differences due to language regression, if any, leaving no significant variations between those with ASD who had language regression to those without language regression.

Social Functioning and Outcome

A composite rating on a 5-point scale ranging from "Very Poor" to "Very Good" of overall social and independent living functioning was based on work status, residential situation, and number and quality of friendships (Howlin et al., 2004). Results of the current study indicate that there were no significant differences between participants with and without language regression in any of the categories, suggesting that language regression does not have an impact on individual scores using the adult outcome categorization scheme.

Overall, an average of 20% of this sample fell in the "Very Good" to "Good" outcome categories, 32% fell in the "Fair" category, and 48% fell in the "Poor" to "Very Poor" outcome categories. These results fall within the wide ranges from previous studies ranging from 14–48% in "Very Good" to "Good", 4–63% in the "Fair" category, and 17–61% in the "Very Poor" to "Poor" categories (see Table 3; Eaves & Ho, 2008; Farley, McMahon, Fombonne et al., 2009; Howlin et al., 2004; Kobayashi et al., 1992; Lotter, 1974; Rutter et al., 1967). These ranges will continue to vary due to differing criteria, sample sizes, and testing procedures. While there are some cases of success in this study, there were also many individuals who struggled with characteristics of ASD and other concerns. It will continue to be beneficial to investigate other contributing factors that predict and affect adult outcomes in order to provide appropriate support and interventions for this population.

Cognitive Abilities

A significant difference existed between childhood Full-Scale IQ scores at Time-1, suggesting that language regression does have an effect on how an individual scores on early measures of overall cognitive abilities; however, results indicate that these differences lessen through adulthood, resulting in Full Scale IQ scores between the two groups that are comparable. Additionally, with adult (Time-2) nonverbal and verbal measures, we were also able to compare Time-2 subscale scores to show that no significant difference existed between those participants with and without language regression on adult cognitive measures. These results indicate that while language regression affects childhood performances, these differences in cognitive ability levels do not last a lifetime and are mitigated with age. With no previous data reporting the long-term effects of language regression on adult cognitive abilities, these results provide compelling information suggesting language regression minimally affects individuals with ASD on a long-term basis.

Gender and Mortality

While it is generally understood that ASD affects males more than females at an estimated 4:1 ratio, there were no gender differences in whether individuals did or did not have language regression. Interestingly, though, analyses of language regression and mortality rates indicated that a higher mortality rate existed for those with early reported language regression. Within this study, this was the *only* analysis that identified any significance as a function of language regression in adulthood. To determine the underlying factors in this relationship, it would be necessary to rule out other predictors

or variables that language regression may impact. For example, several medical and psychiatric conditions are commonly identified in people who also have ASD, such as epilepsy, mood disorders, anxiety disorders, attention deficit-hyperactivity disorder, tics, and psychotic disorders (Ghaziuddin, Weidmer-Mikhail, & Ghaziuddin, 1998; Lainhart, 1999). Eaves and Ho (2008) identified comorbid psychiatric difficulties in 77% of their adult sample including depression, obsessive-compulsive disorder and other anxiety disorders, bipolar disorder, Tourette's disorder, and conduct disorder. It would be beneficial to next identify medical comorbidities as a function of language regression.

Limitations of the Study

This study is limited by a number of factors. While the Epidemiological Survey records have proved to be a rich and valuable data resource with regard to their longitudinal capabilities, standardized data collected from that time is limited. Much information was derived from the records of service providers, who used a wide range of assessment instruments. Additionally, there was substantial variation in the ages at which participants were evaluated by these service providers and during the Epidemiological Survey. Therefore, conclusions drawn from the early cognitive data must be treated cautiously and bear further investigation.

With regard to the measures of language regression in this study, Ornitz's Childhood Inventory was a retrospective developmental written catalog completed by parents when their children were relatively young. However, while the inventory was completed during the childhood years, the collected responses still indicated a lack of precise data regarding when language regression occurred. Having more reliable

information, such as an exact timeline and records of speech production and loss, would enable more specific analyses of the effects of early versus later occurring language regression on various outcome measures. Furthermore, the Ornitz was not rigorously tested for psychometric properties; rather it was used to collect pertinent information in a systematic fashion. Similarly, elderly parents or caregivers who had not known the patients their whole lives completed the ADI language regression scores retrospectively. After 30 years, especially if the parents were unable to remember or could not participate, few consistent scores and rankings existed between the Ornitz and ADI language regression measures. Additionally, retrospective measures and parent/caregiver interviews run the risk of unrealistic views, altered memories, and recall biases of the rater. Another risk of this 30-year longitudinal study was using nonbiological caregivers (group home attendants, etc.) to fill out the ADI and other relevant outcome measures since they may have lacked information on childhood events and occurrences.

Lastly, a significant drop in sample size occurred when dealing with Time-2 cognitive measures. Unlike adaptive and outcomes measures in which parents and caregivers were rating the participants current functioning, cognitive measures must be collected using standardized testing procedures with the subjects. Due to the necessary interaction to calculate cognitive abilities, participation decreased, resulting in smaller sample sizes. This decrease in subject numbers may be contributed to a variety of variables including unwillingness to participate due to behavioral concerns, time constraints, and presenting as untestable due to severely low cognitive abilities. In future studies, it will be beneficial to investigate the reasons behind not being able to collect Time-2 cognitive test scores.

Future Research

Much work has yet to be done to understand how best to support people with ASD across the lifespan. Adult samples may be especially useful in understanding phenotypic variation and the long-term effects of early intervention programs, specifically investigating individuals with ASD with good outcomes and retrospectively targeting childhood interventions that may have encouraged better adult outcomes. Specifically regarding this study, due to the difference in mortality rates between those with and without language regression, the next crucial step will be to identify associated comorbidities within this sample to identify potential predictors for adult outcomes. Finally, it will be critical to develop better research-validated methods for identifying and monitoring language regression to better monitor its potential effects on adult outcomes in the years to come.

Conclusion

Overall, the existing research investigating language regression in ASD is inconclusive and indicates a range of effects and outcomes. Several studies have compared the outcomes of children with and without language regression; however, no studies to date have the longitudinal support of the current study or provide outcome data investigating the early effect of language regression on adult outcomes. Adult outcome results for children with and without language regression suggest that despite language regression occurring in a percentage of children diagnosed with and Autism Spectrum Disorder, this occurrence does not affect later adult outcomes in comparison to those without language regression. This information is compelling, suggesting that while there

are variables that affect the adult outcomes of individuals with autism, language regression is not one of them.

APPENDIX A

LANGUAGE REGRESSION QUESTIONS FROM THE DEVELOPMENTAL INVENTORY

Language Regression Questions from the Developmental Inventory

5-69,70	How old was the child in months when he (she) first began to use words in addition to those meaning "Mama" and "Dada? (Fill in 00 if this behavior never occurred. Fill in 88 if it occurred but you can't remember when. Fill in 99 if you can't answer this question.)
5-71,72	How old was the child in months when he (she) lost the ability in question 5-69,70? (Fill in 00 if this behavior never occurred or if it occurred and has not ended. Fill in 88 if this ability ended but you can't remember when. Fill in 99 if you can't answer this question.)
5-73,74	How old was the child in months when he (she) first began to combine two or three words into phrases? (Fill in 00 if this behavior never occurred. Fill in 88 if it occurred but you can't remember when. Fill in 99 if you can't answer this question.)
5-75,76	How old was the child in months when he (she) stopped this behavior in question 5-73,74? (Fill in 00 if this behavior never occurred or if it occurred and has not ended. Fill in 88 if this ability ended but you can't remember when. Fill in 99 if you can't answer this question.)
5-77,78	How old was the child in months when he (she) first began to use complete sentences? (Fill in 00 if this behavior never occurred. Fill in 88 if it occurred but you can't remember when. Fill in 99 if you can't answer this question.)
5-79-80	How old was the child in months when he (she) lost the ability in question 5-77,78? (Fill in 00 if this behavior never occurred or if it occurred and has not ended. Fill in 88 if this ability ended but you can't remember when. Fill in 99 if you can't answer this question.)

APPENDIX B

LANGUAGE REGRESSION QUESTIONS FROM THE AUTISM DIAGNOSIC INVENTORY (ADI)

Language Regression Question from the ADI

9. Age of First Single Words (If Ever Used) (code in months.) 993 = had some words, then lost 994 = milestone not reached 998 = not known but, apparently normal 997 = not known, but apparently delayed 999 = N/R or not asked
10. Age of First Phrase (If Ever Used) (code in months) 993 = had some phrases, then lost 994 = milestone not reached 998 = not known but, apparently normal 997 = not known, but apparently delayed 999 = N/K or not asked
13. Level of Communicative Language Before Loss 0 = daily, spontaneous and meaningful speech used communicatively, with at least 5 different words used at some point before change (and any of the other skills listed below) 1 = occasional and/or fewer than 5 words used spontaneously and communicatively (alone or in combination with imitative abilities) 2 = produced speech by sounds upon request (may or may not have also spontaneously imitated) 3 = spontaneous imitation of vocalizations (without ever having any completely spontaneous speech), with no elicited imitation or spontaneous communicative speech 8 = no change or loss 9 = N/K or not asked
14. Spontaneous, Meaningful Communicative Speech (at some level) 0 = daily, spontaneous and meaningful speech used communicatively, with at least 5 different words used at some point before change (and any of the other skills listed below) 1 = occasional and/or fewer than 5 words used spontaneously and communicatively (alone or in combination with imitative abilities) 2 = produced speech by sounds upon request (may or may not have also spontaneously imitated) 3 = spontaneous imitation of vocalizations (without ever having any completely spontaneous speech), with no elicited imitation or spontaneous communicative speech 8 = no change or loss 9 = N/K or not asked
15. Words Used Spontaneously But Without Clear Communicative Intent 0 = daily, spontaneous and meaningful speech used communicatively, with at least 5 different words used at some point before change (and any of the other skills listed below) 1 = occasional and/or fewer than 5 words used spontaneously and communicatively (alone or in combination with imitative abilities) 2 = produced speech by sounds upon request (may or may not have also spontaneously imitated) 3 = spontaneous imitation of vocalizations (without ever having any completely spontaneous speech), with no elicited imitation or spontaneous communicative speech 8 = no change or loss 9 = N/K or not asked
16. Simple Syntax 0 = daily, spontaneous and meaningful speech used communicatively, with at least 5 different words used at some point before change (and any of the other skills listed below) 1 = occasional and/or fewer than 5 words used spontaneously and communicatively (alone or in combination with imitative abilities) 2 = produced speech by sounds upon request (may or may not have also spontaneously imitated) 3 = spontaneous imitation of vocalizations (without ever having any completely spontaneous speech),

with no elicited imitation or spontaneous communicative speech 8 = no change or loss 9 = N/K or not asked
17. Articulation 0 = no definite loss 1 = probable loss of specific skill 2 = definitive loss of specific skill 8 = insufficient language to show change in quality 9 = N/K or not asked
73. Areas of Loss: Communication (code 0 if none, 1 if possible, 2 if definite) Before Age 5.0 After Age 5.0

APPENDIX C

OUTCOME FORMULATION GUIDELINES

Outcome Formulation Guidelines

Area	Ratings
Work (Out of School)	0 = employed or self-employed, full-time; full-time higher ed. (includes part-time work, part-time higher ed). 1 = voluntary work/job training or part-time work/higher ed. 2 = supported/sheltered employment 3 = in special center/no occupation
Work (Still in School)	0 = full-time school in mainstream placement 1 = full-time school in special education (pull-out resource) 2 = full-time school in special education unit/continuing after age 18 3 = full time school in highly supported unit – severely impaired, medically fragile
Friendships	0 = > one close friendships involving sharing and exchanges of confidences and a range of different activities together 1 = ≥ relationships that involve some personal shared activities outside a prearranged situation, some initiative taken by the individual, but limited in topics or less than normal responsiveness/reciprocity 2 = people with whom the individual has some kind of personal relationship involving seeking of contact, but only in group situations (clubs, church) or in school or work; friendship that are solely internet based 3 = no friends; no joint activities
Independent (left public school)	0 = living independently 1 = in semi-sheltered accommodation (or still at home) but with a high degree of autonomy 2 = living with parents with some limited autonomy 3 = in residential accommodation with some limited autonomy 4 = specialist autistic or other residential accommodation with little or no autonomy 5 = in hospital care or at home because nowhere else would accept the individual
Independence (in public school)	0 = living at home with a high degree of autonomy 1 = living at home (or another close setting) with moderate autonomy) 2 = living at home with limited autonomy, requires high level of support 3 = in residential accommodation with some limited autonomy 4 = specialist autistic or other residential accommodation with little or no autonomy 5 = in hospital care or at home because nowhere else would accept the individual
Composite of Overall Social	0 = very good outcome – achieving a high level of independence, having some friends and a job (total for all 3 areas above = 0 to 2)

Functioning	1 = good outcome – generally in work but requiring some degree of support in daily living; some friends/acquaintances (total = 3 to 4)
	2 = fair outcome – has some degree of independence, and although requires support and supervision, does not need specialist residential provision; no close friends but some acquaintances (total = 5 to 7)
	3 = poor outcome – requiring specialist provision/high level of support; no friends outside of residence (total = 8 to 10)
	4 = very poor outcome – needing a high level of hospital care; no friends, no autonomy (total = 11)

APPENDIX D

INSTITUTIONAL REVIEW BOARD APPROVED CONSENT FORM

20-Year Outcome of Autism (IRB # 00019602)
University of Utah
William M. McMahon, M.D., Hilary Coon, Ph.D., Megan Farley, Ph.D., and Judith Zimmerman, Ph.D.
CONSENT FORM (July 2011)

Background We are studying adults with autism, their parents, and their children. Many of the adults with autism we are studying were involved in an epidemiologic study of autism in Utah during the 1980s. Our goal is to find out what kinds of outcomes different people with autism have in adulthood. We are trying to collect information from 595 adults with autism spectrum disorders. We hope that we will learn more about autism by learning how different people with specific strengths and weaknesses do over the course of many years. We ask that you consider joining our study. Please ask us questions about anything that is not clear to you.

Much research has been conducted in the field of autism, but not very much has been done on autism in adulthood. We do not clearly understand how development is typical or unusual in people with autism. Understanding what development usually looks like in people with autism will help us understand how individual treatments make development faster or different. In addition, when we know more about the lives of adults with autism, we will be able to help adults with autism, their families, and public agencies plan and make decisions about resources for an adult with autism. By volunteering for our study, you can help in this effort.

Procedure To participate in this study, we will ask you to complete personal interviews, psychological testing, and written questionnaires. Using questionnaires, we will ask about social activities, friendships, and interests. You may fill out the written questionnaires in your home. These questionnaires will take about 2 hours to answer. The personal interviews and psychological testing will be done at our offices in Research Park or in your home, whichever you prefer. The interviews will be videotaped so that we can assure that our interviewers are all asking the same questions and recording your answers reliably. The study team would like to video-tape your interview. This is completely voluntary and optional. You can still participate in the study and not have your interview recorded. If you are willing to allow the study team to record your interview, you will be presented with a second consent form that will allow for the recording. It will take about 4 hours to complete this testing. If the results of your questionnaire responses, personal interviews, or psychological testing disclose a problem that deserves further diagnosis or treatment, we will assist you by discussing potential follow-up with you and making a referral to the appropriate health care professional.

Risks There are few risks associated with this study. Our interview questions may seem unusual if you have never had any symptoms, but are not likely to cause any worries or psychological problems you have not already had. Your identifying information is stored with the utmost security, and is separate from clinical data. In the very unlikely event that all of our security barriers are breached, there is a small possibility that your clinical data could result in insurance or employment discrimination.

Benefits There may be no immediate or direct benefits to you or your family. Participants will receive a free evaluation and accompanying report. If studies here are successful, better understanding of the natural course of autism and adult outcome for people with autism may result in knowledge relevant to improved treatment.

Alternative Procedures You have the option of not participating.

Voluntary Participation Your participation in this study is voluntary. If you choose to participate, you will be asked to sign this form. Even if you sign this form, you may withdraw at any time without giving a reason. Your withdrawal will not affect the relationship you have with the investigators or staff, nor the standard of care you receive. If you wish to leave the study, contact William McMahon at (801)585-9098.

Confidentiality. Your records will not be released to any person or institution without your written consent. Paper files will be stored in a locked storage room in our research space. Computer data are stored in encrypted database files. Identifying information is kept separate from study data. Computers are protected by a computer firewall and secure usernames and passwords. A portion of the funding for this study comes from Autism Speaks, who requires periodic progress reports. Progress reports and published accounts of research results will not reveal your identity. Your data will be stored until our research is complete (i.e., indefinitely). Utah law requires us to advise you that we must report any suspected or actual abuse, neglect, or exploitation of a child, an adult 65 or older, or an adult who has a mental or physical impairment which affects that person's ability to provide for or protect him/herself. Under any of the above circumstances, a report will be filed with Child Protective Services, Adult Protective Services, or a law enforcement agency.

Person to Contact Questions concerning this research project should be directed to Drs. William McMahon or Hilary Coon at (801) 585-9098. After business hours, you may call the University of Utah Neuropsychiatric Institute at (801) 583-2500 and ask the operator to page Dr. McMahon. If you feel you have been harmed as a result of participation, or if you have any complaints or concerns, please contact the study team.

Institutional Review Board Contact the Institutional Review Board (IRB) if you have questions regarding your rights as a research participant. Also, contact the IRB if you have questions, complaints or concerns which you do not feel you can discuss with the investigator. The University of Utah IRB may be reached by phone at (801) 581-3655 or by e-mail at irb@hsc.utah.edu. Research Participant Advocate: You may also contact the Research Participant Advocate (RPA) by phone at (801) 581-3803 or by email at participant.advocate@hsc.utah.edu. You may also contact Tyler Black, IRB representative for the Utah Department of Human Services at (801) 538-4271.

Research-Related Injury If you are injured from being in this study, medical care is available to you at the University of Utah, as it is to all sick or injured people. The University of Utah has not set aside any money to pay the costs for such care. The University will work with you to address costs from injuries. Costs would be charged to you or your insurance company (if you have insurance), to the study sponsor or other third party (if applicable), to the extent those parties are responsible for paying for medical care you receive. Since this is a research study, some health insurance plans may not pay for the costs. By signing this consent form you are not giving up your right to pursue legal action against any parties involved with this research.

The University of Utah is a part of the government. If you are injured in this study, and want to sue the University or the doctors, nurses, students, or other people who work for the University, special laws may apply. The Governmental Immunity Act of Utah is a law that controls when a person needs to bring a claim against the government, and limits the amount of money a person may recover. See sections 63G-7-101 to -904 of the Utah Code.

Unforeseeable risks There may be risks associated with this study not currently known.

Right of Investigator to Withdraw Subject The investigator(s) may discontinue all or part of the subject's participation in the study at any time if it is determined by the investigator(s) that participation may jeopardize the safety of the subject, or for any other reason, without regard to the subject's or parents' consent.

Costs and Compensation There will be no charge to you for any of the study procedures or materials. You will receive $50 for completing all of the questionnaires, interviews, and testing.

New Information. If, during this study, new information becomes available that could influence your willingness to continue participating, that information will be provided to you.

Number of Subjects During the course of this research project, we expect to study each of the 426 participants from the epidemiologic study of autism in Utah that was conducted in the 1980s.

Authorization to Use and Disclose Protected Health Information for Research

Signing this document means you allow us, the researchers in this study, and others working with us to use information about your health for this research study. You can choose whether or not you will participate in this research study. However, in order to participate you have to sign both the consent form and this authorization.

This is the information we may use:

-Name

-Address

-Telephone number

-Family medical history

-Social Security number (we will only use this to pay you; we will keep it for our tax records in a secure file that is separate from the rest of your information)

-Psychometric testing, interviews, and written questionnaires, including an IQ test, language tests, and interviews about your/your child's development

-Prior medical and psychometric testing records (see above), including growth charts, vaccinations, and labor and delivery records (we will only obtain these from doctors that you specify, and only with your written request for records release)

Others who will have access to your information for this research project are the University 's Institutional Review Board (the committee that oversees research studying people) and authorized members of the University's workforce who need the information to perform their duties (for example: to provide treatment, to ensure integrity of the research, and for accounting or billing matters). If we share your information with anyone outside the University of Utah Health Sciences Center, you will not be identified by name, social security number, address, telephone number, or any other information that would directly identify you, unless required by law. In records and information disclosed outside of the University of Utah Health Sciences Center, your information will be assigned a unique code number. All identifying information will be removed. We will keep the key to the code in our secure file room. No identifying information will be given to collaborators.

You may revoke this authorization. **This must be done in writing.** You must either give your revocation in person to the Principal Investigator or the Principal Investigator's staff, or mail it to: Dr. William M. McMahon, 650 Komas Dr. Suite 206, Salt Lake City, UT 84108. If you revoke this authorization, we will not be able to collect new information about you, and you will be withdrawn from the research study. However, we can continue to use information we have already started to use in our research, as needed to maintain the integrity of the research. Because this is a longitudinal study, we will keep your information in our secure storage system for future analyses.

This authorization does not have an expiration date. After you sign this, you will be given a copy with your signature.

Participation in future studies When analyzing changes over time, it is very useful to have more than 2 data points (i.e., occasions when we collect information about a person's symptoms and functioning). We would like to contact you again in the future to discuss your progress. If you give us permission to contact you in the future, that does not mean you will still agree to participate when we contact you. You would only be giving us permission to contact you. Please read the sentence below, think about your choice, and mark "**YES**" or "**NO**". Your decisions will not affect your medical care.

May the University of Utah or its research partners contact you for involvement in future research?

YES, the University of Utah or its research partners may contact me regarding participation in future research studies.

NO, I do not wish to be contacted regarding future research studies.

If you granted permission for the University of Utah or its partners to contact you for possible involvement in future research, the Institutional Review Board will review and approve each new project. The Institutional Review Board may require that you be contacted for your permission prior to the use of previously collected information in a new project if it determines new consent is required for your protection. You have the right to withdraw your consent in the future. If you wish to do this, you will need to notify the investigator of your decision.

Consent I agree to participate in this study and I understand that my participation is completely voluntary. I authorize you to use and disclose health information about me for this study, as you have explained in this document. I have read the above information and discussed any questions I may have had with Dr. McMahon or one of the other research staff. I have received a copy of this consent form. My name or other information that could identify my family or me will not be released.

_____ _____
Printed Name of Participant Date

_____
Signature of Participant

For Use in Cases Involving a Legally Authorized Representative:
I confirm that I have read this consent and authorization document. I have had the opportunity to ask questions and those questions have been answered to my satisfaction. I am willing and authorized to serve as a surrogate decision maker for:

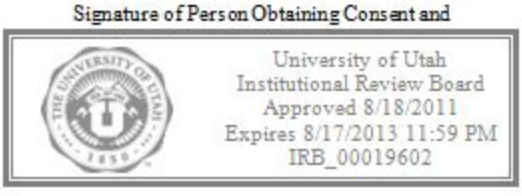
_____
Participant's Name

I have been informed of my role and my obligation to protect the rights and welfare of the participant. I understand that my obligation as a surrogate decision maker is to try to determine what the participant would decide if the participant were able to make such decisions or, if the participant's wishes cannot be determined, what is in the participant's best interests. I will be given a signed copy of the consent and authorization form to keep.

_____ _____
Printed Name of Legally Authorized Representative Signature of Legally Authorized Representative

Indicate the legal representative's authority to act for the individual:
☐ Spouse
☐ Adult (18 years of age or over) for his or her parent
☐ Individual with power of attorney
☐ Guardian appointed to make medical decisions for individuals who are incapacitated

_____ _____
Printed Name of Person Obtaining Consent and Signature of Person Obtaining Consent and



Authorization (UUHSC staff)

Authorization (UUHSC staff)

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